



GRADUATE STUDIES NEWS

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Graduate Studies in Building Engineering

The Discipline

The Centre for Building Studies (CBS) at Concordia University offers educational and research programmes in Building Engineering which are unique in the Canadian university community. Four main specializations of building engineering are offered: Building Environment, Building Science, Building Structures and Construction Management. Programmes in Building Engineering lead to the following degrees: a Bachelor, a Master of Applied Science and a Master of Engineering in Building Engineering, as well as a Ph.D. in Building Studies.

The Centre offers four Specializations:
Building Environment: studies pertaining to the design, analysis and operation of energy efficient, healthy and comfortable buildings. Fields of specialization include: thermal comfort, air quality, lighting, acoustics, HVAC and control systems.

Building Science: the knowledge underlying the physical phenomena that control the performance of buildings and its application to the design of building enclosures and their components.

Building Structures: the principles of structural mechanics, material behaviour and their applications to the analysis and design of steel, reinforced concrete and timber building structures. Fields of specialization include: wind and seismic effects on buildings.

Construction Management: the body of knowledge pertaining to the construction methods and project management tech-



niques includes decision support systems; planning; cost estimation; scheduling; tracking and control; legal issues in construction; contracts administration and management of claims; labour and industrial relations, advanced computer systems.

The Centre offers a learning experience and provides an ambiance which enables students to fulfil professional aspirations and assume leadership positions in one of Canada's most challenging and exciting industries.

Objectives of the Programme

The thrust of the programme is to train future leaders for the building industry. The programme provides opportunities for qualified students to acquire knowledge to participate effectively as professionals in the process of planning, design, construc-

Doctoral seminar held every Tuesday afternoon at the Centre for Building Studies.

tion, operation and maintenance of buildings together with their interaction and im-

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pact on the surrounding environment.

The Centre links complementary disciplines. The design and operation of healthy buildings requires an interdisciplinary approach and this challenge is being met by the Building Engineering programme which draws upon the expertise of Civil, Mechanical, and Electrical Engineering, as well as Architecture.

Research

Research at the Centre for Building Studies generates technological expertise to create higher quality buildings at a lower cost. Researchers have distinguished themselves as expert resources not only in teaching, research and service for the community but also in specific fields such as: Energy Conservation; Building Envelope Failures; Indoor Air-Quality; HVAC Systems; Computer Applications for the Building Industry; Wind Effects on Buildings; Sealants and Polymer Applications; Passive Solar Applications; Structural Performance of Buildings; Natural Gas Technologies; Testing of Thermal Insulation; Daylighting in Buildings; Construction Management Procedures; Development of New Building Materials; Building Acoustics.

The Centre has excellent research facilities and expertise available to government and industry in all aspects of building engineering. Governments view the Centre as a major resource in developing the construction industry in Québec and in Canada, allowing them to compete in world markets.

Modern Laboratories and Special Equipment

The Centre for Building Studies has a well established laboratory infrastructure in the area of building materials, thermal analysis (which is accredited by the Standard Council of Canada), building envelope, thermal insulation materials, energy efficiency and thermal environment, indoor environment, building aerodynamics, computer aided building design, building structures, building acoustics and daylighting.

Several new laboratories have been devel-

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oped at the Centre: a building envelope laboratory, and two fully instrumented outdoor test-rooms, one for investigation of wind pressures on buildings and the other for research on several types of computer-controlled heating systems. The most recent realization is the **Environmental Chamber** for testing new concepts of the building envelope. Located in downtown Montréal near the Sir George Williams campus of Concordia University, this full-scale laboratory, the first of its kind in Canada, uses the latest technology in testing and monitoring the building envelope systems. It will enable research on the dynamic performance of building envelope components, studies of dynamic thermal control and air and contaminant flow between zones. The Chamber will be used for validation of much of the software and computer control strategies and algorithms developed under this programme.

Other facilities include a heat exchanger performance testing apparatus, a rain penetration chamber and an earthquake bed. A fabrication shop provides the necessary resources to prepare special research samples of equipment for use in research and experimentation. Instrumentation and calibration facilities are also provided.

The Computer Aided Building Design laboratory is equipped with a variety of processors and peripherals, including an IBM RISC workstation 5000, a DEC VAX station 3100 and powerful microcomputers (285-386-, 486-based) with an array of input and output devices. The Centre also has several micro-computers for course work with an extensive selection of engineering application software. Students have access to the University's Computer System, which consists of a network of VAX minicomputers, SUN work-

stations and several microcomputer laboratories. They may also participate in SIRICON, a non-profit corporation, that develops software, computer applications and new tools to transfer the latest technologies to the construction industry.

Employment Opportunities

Building engineers learn the various phases in the life cycle of a building, be it commercial, residential, industrial or institutional, and develop an appreciation of the building as an advanced technological system. With this knowledge, they are able to work with industries, governments, consultants, contractors, research centres and educational establishments. This competence enables the development of new techniques in the field of building engineering.

Links to Government Agencies and Industry

The Centre for Building Studies collaborates with Ministries such as Énergie et des Ressources Québec, Industrie Science et Technologie Québec, Natural Resources Canada, Public Works, and with IRC, World Bank-Energy Sector, Environmental Protection Agency USA, Hydro-Québec, Bell Canada, City of Montreal, etc.

For further information please contact:
Centre for Building Studies
Concordia University
1455 de Maisonneuve Blvd. West
Montreal, Quebec H3G 1M8
Telephone: (514) 848-3200
Fax: (514) 848-7965

EDITORIAL COMMITTEE:
Chair: M. Kusy
Editor: D. MacFadden
Photographer: W. Cross
Typesetting: R. Nantel
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Montreal, Quebec H3G 1M8
LOCATION:
2145 MacKay Street
Tel. (514) 848-3808,
Fax: (514) 848-2812

Faculty and Student Research in the Area of Energy in Buildings

by Phil Moscovitch

Research in the area of efficient use of energy in buildings constitutes one of the main priorities of the Centre, as there is an increasing demand from the industry and government. Faculty members and graduate students both benefit from the unique way in which Concordia's Centre for Building Studies draws on a variety of disciplines. Civil, mechanical, chemical and electrical and computer engineering, as well as architecture, are brought together as researchers develop and evaluate new building materials and techniques.

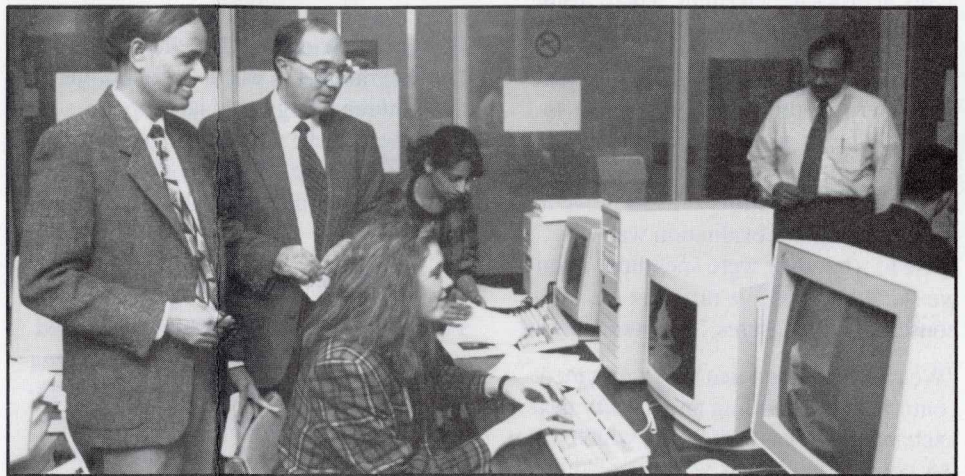
"We are fortunate in the sense that we have a group of very dedicated people all directing their research to the one central goal of efficient buildings — be it in operation, design, analysis, monitoring, or construction in different phases," says Associate Professor Mohammed Zaheeruddin, an expert in heating, ventilating, and air-conditioning (HVAC) control systems. "When you see such a concentration of people in one area it gives a feeling of belonging to a group in which your work will be of value."

Interdisciplinary Approach

Associate Professor Radu Zmeureanu agrees, adding that "in the type of doctoral seminar we have, we learn from other areas in our Centre — such as building science, knowledge-based systems, and acoustics — and this helps all of us. At the same time, students leaving this department have a broader view of the discipline, not limited to, say, energy efficiency or indoor air quality."

Intelligent Building Control Systems

For the last three years, Zaheeruddin, a member of the faculty since 1987, has been working on designing decentralized control systems for large-scale commercial and institutional intelligent buildings.



Lora Pasqualetto, Master of Applied Science student, with her supervisor Dr. Radu Zmeureanu and Dr. Mohammed Zaheeruddin in the computer lab.

Many new buildings are equipped with energy management control systems in which a central computer monitors thousands of control points (such as the presence or absence of people, temperature and humidity) and makes adjustments accordingly. These adjustments (controller tuning) are based on empirical methods and trial and error. This leads to controller interaction problems and loss of control.

"To overcome this problem, we have proposed a method of decentralization of the large HVAC system in a building into local area stations. That is, you break down a big problem into smaller stations and then design controllers for each of these local stations in such a way that the overall performance of the system is improved," Zaheeruddin explains.

He notes that "this technique seemed to work very well. Our results show that you can achieve optimum performance through this concept of decentralization, and that decentralized controllers are good candidates for intelligent building management control systems."

Zaheeruddin has worked with several graduate students and also with Professor R.V. Patel from the Department of Electri-

cal and Computer Engineering. They have developed a methodology for the design of decentralized controllers. Within the next year they hope to be conducting experimental research on laboratory-scale systems at the Centre.

Further tests are "required in terms of analysis, using computers, to prove that these design techniques can be applied to all HVAC systems," Zaheeruddin said.

At this stage, however, it would appear that decentralized controllers could control temperature just as effectively as the more expensive centralized systems. Zaheeruddin added that "in terms of energy consumption it is a bit hard to say at this point, until experiments are conducted to see if we lose any performance due to decentralization."

Like Zaheeruddin, Zmeureanu does research in the area of building environment, although his focus is on energy consumption and energy efficiency.

Energy Consumption and Energy Efficiency

He recently worked, in conjunction with two graduate students, on a project to evaluate the energy performance of a 136-year old building owned by the City of

Montréal. The team spent two weeks measuring aspects of the building's physical environment, such as the level of lighting and the air infiltration rate. They also used an infrared camera to photograph the walls in order to determine where insulation could be improved.

"We introduced all the data that we recovered after spending about two weeks in the building to get all this information. We developed a computer model and calibrated it with the utility bills to prove to the client that our evaluation was very close to what they were spending. Then we started to evaluate different energy conservation measures," Zmeureanu said.

"We recommended that they implement controls in the building and modify heat exchangers. It was something which, from our point of view, was very interesting — to have an experimental lab [the building] and to apply these programmes."

Similar projects have been carried out at other buildings in the Montréal area. Zmeureanu stresses, however, that what is most important to him is not their value to the owners of the buildings, but their research potential. "We are not consultants," he said. "We are not bidding to get projects and to have contracts — that is not our objective."

Evaluating Concordia's Hall Building

Zmeureanu completed his doctorate at the Centre, with Professor Paul Fazio, founding Director of the Centre, before becoming a full-time faculty member in 1987. He is currently working on several research projects. One of them involves evaluating the energy consumption of Concordia's Henry F. Hall Building. In this case data will come, not only from utility bills and information provided by building managers, but from equipment which will actively monitor consumption.

"We have installed data acquisition equipment on one chiller and one large HVAC system for the whole building. In addition, we have access to some information from the energy monitoring and control system in the Hall building," Zmeureanu says.

Putting together the two sets of data will

provide him with a fairly complete picture of how the building uses energy. "At the same time," Zmeureanu adds, "we are developing some programmes to help us analyze and evaluate all this information."

Lora Pasqualetto, a student in the Master of Applied Science in Building Engineering Programme, is working on a project to assess three energy simulation programmes. These are software packages that evaluate the effects of various changes to a building's energy consumption.

Energy Simulation Software

For her thesis, which is being supervised by Zmeureanu, Pasqualetto is developing a methodology that could be used to validate energy simulation software. She is looking specifically at a new programme called BESA-Design.

"I'm hoping that it might be more widely used in Canada since it's a Canadian product — and if the developers are in Canada it'll be easier to get in touch with them if there are programming bugs," Pasqualetto said.

She and Zmeureanu have been simulating the effects of a variety of changes on a seven-storey office building in Laval. According to Zmeureanu, "it's a real case in a real building — it's an ideal situation. You can't evaluate this using a fictitious building or using simplified mathematical models."

The information derived from the simulation will provide a case study to complement Pasqualetto's methodology. She has already discovered what she called "a few very obvious bugs" in BESA-Design.

Pasqualetto, who holds a scholarship from the Natural Sciences and Engineering Research Council, did her undergraduate degree in Building Engineering at Concordia, and became interested in energy efficiency: "In my last year I took energy conservation with Dr. Zmeureanu and I was fascinated."

In the summer of 1992 she worked for a consulting firm evaluating the energy efficiency of a thousand Montréal homes.

Interdisciplinary Speaker Series

The School of Graduate Studies will be hosting an Interdisciplinary Speaker Series during the 1993-94 academic year.

The School of Community and Public Affairs' Visiting Scholar, **Dr. Mihailo Crnobrnja** will speak at the following lecture series: **The Challenges of Contemporary Europe.**

Date: Tuesday, January 25, 1994

Time: 8:30 p.m.

Place: H-767

Title: The Pains and Prospects of Transition in Eastern Europe

Date: Wednesday, March 16, 1994

Time: 8:30 p.m.

Place: H-767

Title: East and West: New Bridges and New Divides

All members of the university community are welcome to attend.

For further information, contact Dr. Dorothy Markiewicz, Associate Dean, School of Graduate Studies, 848-3894.

Pasqualetto began her graduate work in January of 1993, and hopes to graduate in the spring of 1995.

One of the key reasons she decided to pursue graduate studies at the Centre for Building Studies, she said, is that "if you're into energy conservation, Dr. Zmeureanu is *the* expert in that field."

Pasqualetto plans to return to the job market once she completes her graduate studies. "I'd like to work in an engineering consulting firm doing energy audits and energy evaluation," she said.

Both Zmeureanu and Zaheeruddin commented on the positive effects being located in Montréal has on their research. They believe that "our location in Québec will help us act as a bridge between North American and European technologies."